In the first place, it is clear that the continuous sheet of cork (*Co*) must first be extended, and finally ruptured, by the pressure exerted from within: it is true, this layer is very elastic and extensible, and impervious to water or nearly so—in fact it is a thin layer or skin, with properties like those of a bottle cork—but even it must give way as the cylinder goes on expanding, and it cracks and peels off. This would expose the delicate tissues below, if it were not for the fact that another layer of cork has by this time begun to form below the one which is ruptured: a cork-forming layer arises along the line ϕ, and busily produces another sheet of this protective tissue in a plane more or less exactly parallel with the one which is becoming cracked. This new cork-forming tissue behaves as before: the outer cells become cork, the inner ones add to the green succulent parenchyma-cells (*pa*). As years go on, and this layer in its turn splits and peels, others are formed further inwards, and if it is remembered that a layer of cork is particularly impervious to water and air, it is easy to understand that each successive sheet of cork cuts off all the tissues on its exterior from participation in the life processes of the plant: consequently we have a gradually increasing *bark* proper, formed of the accumulated cork-layers and other dead tissues.

A great number of interesting points, important in their proper connections, must be passed over here. Some of these refer to the anatomy of the various "barks"—the word "bark" being commonly used in commerce to mean the whole of the cortical jacket—the places of origin of the cork-layer, and the way in which the true bark peels off: those further interested here may compare the plane, the birch, the Scotch pine, and the elm, for instance, with the oak. Other facts have reference to the chemical and other substances found in the cells of the cortex, and which make "barks" of value commercially. I need only quote the alkaloids in Cinchona, the fibres in the Malvaceæ, the tannin in the oaks, the colouring-matter in *Garcinia* (gamboge), the gutta-percha from *Isonandra*, the ethereal oil of cinnamon, as a few examples in this connection, since our immediate subject does not admit of a detailed treatment of these extremely interesting matters.

The above brief account may suffice to give a general idea of what the cortical jacket covering our timber is, and how it comes about that in the normal case the thickening of the cylinder is rendered possible without exposing the cambium and other delicate tissues: it may also serve to show why bark is so various in composition and other characters. But it is also clear that this jacket of coherent bark, bound together by the elastic sheets of cork, must exert considerable pressure as it reacts on the softer, living, succulent parts of the cortex, trapped as they are between the rigid wood cylinder and the bark; and it is easy to convince ourselves that such is the case. By simply cutting a longitudinal slit through the cortex, down to near the cambium, but taking care not to injure the latter, the following results may be obtained. First, the bark gapes, the raw edges of the wound separating and exposing the tissues below; next, in course of time the raw edges are seen to be healed over with cork—produced by the conversion of the outer cells into cork-cells. As time passes, provided no external interference occurs, the now rounded and somewhat swollen cork-covered edges of the wound will be found closing up again; and sooner or later, depending chiefly on the extent of the wound and the vigour of the tree, the growing lips of the wound will come together and unite completely.

But examination will show that although such a slit-wound is so easily healed over, it has had an effect on the wood. Supposing it has required three years to heal over, it will be found that the new annual rings of wood are a little thicker just below the slit; this is simply because the slit had released the pressure on the cambium. The converse has also been proved to be true—*i.e.* by increasing the pressure on the cambium by means of iron bands, the annual rings below the bands are thinner and denser than elsewhere.

But we have also seen that the cambium is not the only living tissue below the bark: the cortical parenchyma (*pa*), and the cells (*c*) of the inner cortex (technically the phloem) are all living and capable of growth and division, as was described above. The release from pressure affects them also; in fact, the "callus," or cushion of tissue which starts from the lips of the wound and closes it over, simply consists of the rapidly growing and dividing cells of this cortex, *i.e.* the release from pressure enables them to more than catch up the enlarging layer of cortex around the wound.

An elegant and simple instance of this accelerated growth of the cortex and cambium when released from the pressure of other tissues is exhibited in the healing over of the cut ends of a branch, a subject to be dealt with later on; and the whole practice of propagation by slips or cuttings, the renewal of the "bark" of Cinchonas, and other economic processes, depend on these matters.

In anticipation of some points to be explained only if these phenomena are understood, I may simply remark here that, obviously, if some parasite attacks the growing lips of the "callus" as it is trying to cover up the wound, or if the cambium is injured below, the pathological disturbances thus introduced will modify the result: the importance of this will appear when we come to examine certain disturbances which depend upon the attacks of Fungi which settle on these wounds before they are properly healed over. In concluding this brief sketch of a large subject, it may be noted that, generally speaking, what has been stated of branches, &c., is also true of roots; and it is easy to see how the nibbling or gnawing of small animals, the pecking of birds, abrasions, and numerous other things, are so many causes of such wounds in the forest. H. MARSHALL WARD.

(*To be continued.*)

NOTES.

On Friday, the 23rd inst., Sir Henry Roscoe drew attention in the House of Commons to the Woolwich regulations, the mischievous nature of which we have repeatedly exposed. Sir Henry Roscoe was cordially supported by Sir Lyon Playfair; and Mr. Stanhope, we are glad to say, dealt with the subject in a fair and conciliatory spirit. He promised to discuss the matter with men of science, and the result, we may hope, will be that new regulations will soon be drawn up, securing that scientific candidates shall not be placed at a disadvantage as compared with students of language and literature.

In replying to Sir Henry Roscoe, Mr. Stanhope made a statement to the effect that the regulations now in force for Sandhurst, which were issued in 1884, were recommended by upwards of fifty head masters. We have before us the Report of the Head Masters' Conference for 1883, in which the recommendations of their Committee are printed, and these recommendations differ in certain important respects from the regulations actually adopted by the War Office. The head masters appear, from their suggestions, to have desired to retain a more important place for Latin and Greek than those subjects occupy in the War Office regulations; and they also attached a higher value to higher mathematics. On the other hand, they placed modern languages and experimental science on a lower but relatively less unequal footing than the War Office has done. Although, therefore, in consequence of the position of classics, the actual value of science was, on the whole, perhaps not better under the head masters' suggestions than under the regulations issued by the War Office, it is hardly correct to speak of the head masters as having recommended a scheme of which the predominating fault is, as we think, the undue difference in the marks allotted to modern languages as compared with the experimental sciences. Moreover, even if Mr. Stanhope were right, it would not follow that the head masters contemplated the application of their suggestions in all respects to the scientific branches of the Army, since the needs of those branches are so obviously different in certain matters. We quite recognize the necessity pointed out by the Secretary of State for War, that the system of the Royal Military Academy (Woolwich) and that of the Royal Military College (Sandhurst) should be as much as possible assimilated to each other. But for that very reason the needs of the Woolwich cadets in the case of science should have been more carefully considered in the framing of the Sandhurst regulations. No one will contend that scientific capacity is a bad thing for a Sandhurst cadet, and since it is admittedly of direct and very great importance to secure scientific capacity on the part of Woolwich cadets, it appears reasonable that, in the case of science subjects, the needs of the Woolwich system should be chiefly regarded, if in this respect the two systems must be made similar.

TEN Fellows of the Royal Society have died in less than four months—a large number when we take into account that the annual death-rate is barely fifteen. Six out of the ten gave an average age of seventy-nine.

THE annual general meeting of the Chemical Society was held yesterday. Mr. Crookes, F.R.S., the President, read a report on the state of the Society, and an address on elements and meta-elements. The medal founded, for triennial award, by Dr. Longstaff, was conferred on Dr. W. H. Perkin, F.R.S. The President, in presenting the medal, expressed the pleasure he felt in thus testifying, in the name of the Society, to the value of Dr. Perkin's interesting and important researches on the magnetic rotary polarization of compounds in relation to their chemical constitution. Mr. Crookes also took the opportunity of congratulating Dr. Longstaff on the fact that although on the eve of his eighty-ninth birthday he is still hale and hearty.

THE half-yearly general meeting of the Scottish Meteorological Society was held yesterday in the hall of the Royal Scottish Society of Arts, Edinburgh. In their Report the Council state that, in addition to the routine work of the Office, the Secretary's time has been occupied with the preparation of the Report on the Ben Nevis observations from the opening of the Observatory in November 1883 to the end of December 1887, and in seeing these observations through the press. The work, which is to appear as an extra volume of the Transactions of the Royal Society of Edinburgh, is in a state of forwardness, the whole of the observations proper of the Observatory being now through the press. The Council also note that the physical and biological researches have been conducted on the *Medusa* during the winter months with characteristic vigour, and with a success so great as to point to the solution of the questions raised by the herring and salmon fisheries, while at the same time an entirely new light has been cast on the circulation of the water in our fresh and salt water lochs, and generally on the problem of oceanic circulation.

AN influential Committee has been formed at Edinburgh for the purpose of collecting subscriptions for a memorial of the late Prof. Kelland. An appeal has been issued to his former students and others, and it ought to meet with a prompt and generous response. Prof. Kelland, as the Committee remind those whom they have addressed, was not only an excellent and most successful teacher of mathematics, loved and honoured by the students of forty sessions at the University of Edinburgh, but one of the most effective recent promoters of the cause of education in Scotland. The precise nature of the memorial will to some extent depend upon the amount subscribed; but it will be essentially a foundation bearing the name of Kelland, such as a Scholarship, or even a special Lectureship, in connection with the Chair of Mathematics at the University of Edinburgh.

THE Irish Exhibition, which is to be held at Olympia, Kensington, from June 4 next to October 27, ought to be one of very great interest. The intention is that the English public shall have an opportunity of obtaining a clear view of the predominant industries of Ireland. It is also proposed to exhibit some of her historical and antiquarian treasures. The profits are to be given in aid of Irish technical and commercial schools.

THE eighth German Geographentag, which was to have been held at Berlin in April, has been postponed. The Committee, in announcing this decision, explain that the festivities which might, as usual, be connected with the meeting would not be in accordance with the feeling excited in the capital by the death of the Emperor William.

THE *Standard* of Wednesday, March 21, printed some extracts from the letters of Cowper, the poet, which may serve to show that the climate of England has not deteriorated, bad as it has lately been. In a letter dated March 19, 1788, Cowper writes to his friend Bagot:—"The spring is come, but not that spring which our poets have celebrated. So I judge, at least, by the extreme severity of the season—sunless skies and freezing blasts, surpassing all that we experienced in the depth of winter. How do you dispose of yourself in this howling month of March? As for me, I walk daily, be the weather what it may, take bark, and write verses. By the aid of such means as these I combat the north-east wind with some measure of success, and look forward—with the hope of enjoying it—to the warmth of summer." On May 6 he says to Lady Hesketh:—"I am just recovered from a violent cold, attended by a cough. I escaped these tortures all the winter; but whose constitution or what skin can possibly be proof against our vernal breezes in England? Mine never were nor will be." Yet only three weeks afterwards (May 27) he exclaims to the same correspondent:—"How does this hot weather suit thee, my dear, in London? As for me, with all my colonnades and bowers, I am quite oppressed by it." It would be interesting if some one could provide particulars as to the weather of any of the former '88 years.

THE *American Meteorological Journal* for February devotes an article to the works of Prof. William Ferrel, now seventy-one years of age. His first meteorological papers were published in the form of essays in 1856, and were reprinted and extended, under the title of "Motions of Fluids and Solids on the Earth's Surface," as one of the professional papers of the Signal Service. In this paper the explanation of the trade winds is altogether different from that usually given. His latest contribution—"Recent Advances in Meteorology" (see NATURE, vol. xxxvi. p. 255)—is the best summary of the principles and results of meteorology in existence. Ferrel's views received considerable attention in France soon after publication, but in this country and in America they have only attracted notice more recently. His mathematical papers on the motions of the ocean are not less important than those on the motions of the atmosphere. The article is accompanied by a good portrait of Prof. Ferrel.

WE have received from Dr. Van der Stok the rainfall observations made in the East Indian Archipelago during the year 1886. Observations are now taken at 102 stations, several additions having been recently made, including an important station on the Key Islands, in longitude 132° 45′ E.; the district now represented extends over 37° of longitude. The data published include the monthly and yearly values for the year 1886, and the means for a number of years, the number of days of rainfall, and the greatest falls in twenty-four hours. The value of the work would be much enhanced by the addition of charts showing the distribution in space and time, and by some discussion of the results. It has been shown by M. Woeikof that the rainfall of stations close together differs materially. For instance, at Batavia the proportion of rainfall in the wettest and driest months is 8 to 1, while at Buitenzorg, only 25 miles distant, the proportion is only 2 to 1. The work contains a short account of the position of every station.

The Central Physical Observatory of St. Petersburg has published a memoir on the rainfall of the Russian Empire (506 pp. 4to) with an atlas. The data used in the calculations are brought down to the year 1882, and include observations taken at 450 places, embracing altogether 3112 years. The tables contain individual monthly and yearly values, and the means for the whole period, rainfall frequency, and maximum falls in twenty-four hours. The influences of the form of gauge and exposure on the amounts of rainfall, and of the method of reckoning days of rain, are fully discussed. The amount taken as representing a rainy day is ·004 inch, while in England it is ·01 inch. It is shown that the difference in the methods of counting rainy days materially interferes with the calculations based upon rainfall frequency.

A series of highly interesting experiments upon the vapour-density of ferric chloride have lately been completed by Drs. Grünewald and Victor Meyer. The chlorides of aluminium and indium have already been shown by Nilson and Pettersson, and by V. and C. Meyer respectively, to possess the molecular formulæ $AlCl_3$ and $InCl_3$; it therefore became most important to determine, if possible, whether the molecule of the corresponding chloride of iron possessed, as has been so generally supposed, the constitution Fe_2Cl_6, or $FeCl_3$. The pure ferric chloride for use in the experiments was obtained by gently heating fine iron wire in a stream of dry chlorine gas and re-subliming the product, thus obtaining the salt in beautiful hexagonal plates, exhibiting a fine green colour by reflected, and a purple tint by transmitted light. The first determination was carried out in a bath of vapour of boiling sulphur (448° C.). At this temperature, the lowest at which vapour-density estimations are possible, the volatilization is very slow, but occurs without the slightest decomposition. And yet the vapour-density obtained was considerably lower than that required by the formula Fe_2Cl_6, showing that at no temperature does ferric chloride possess the molecular formula Fe_2Cl_6, but must of necessity consist of molecules corresponding to the simpler formula $FeCl_3$. On repeating the determinations at higher temperatures in baths of phosphorus pentasulphide (518°) and stannous chloride (606°), and in a platinum apparatus heated in a Perrot furnace to temperatures of 750°, 1050°, and 1300°, the numbers obtained gradually approached the vapour-density of $FeCl_3$, the only unfortunate circumstance being that decomposition into ferrous chloride and chlorine occurred as the temperature was increased. However, on repeating the observations in an atmosphere of chlorine, results almost identical with the former ones were obtained; hence there can be no doubt that the true formula of ferric chloride is not Fe_2Cl_6, but $FeCl_3$. It follows from this as a matter of course that the former view as to the tetrad nature of iron must be laid aside. It will be of great interest, in view of this somewhat unexpected result, to learn the results of the determinations of the vapour-density of the lower chloride of iron, which, we understand from Prof. Meyer, are being undertaken by Profs. Nilson and Pettersson.

A third edition of "Practical Amateur Photography," by Mr. C. C. Vevers, has just been issued. This little manual is intended to serve as a text-book for the beginner and a handy work of reference for the advanced photographer, and care has been taken to make it eminently practical.

An interesting book on "Tank Angling in India," by Mr. H. Sullivan Thomas, has been published at Madras and in London (Hamilton, Adams, and Co.). Anglers in India will find in the little work—in which there are some fairly good illustrations—an immense amount of information about paste-baiting, live-bait picketing, live-bait with a float, worm and prawn fishing, localities suitable for tank-fishing, stocking ponds, the mainspring of fish-life, and names, description, and habitat of fish.

In No. 124 of the Proceedings of the Royal Society of Edinburgh (session 1886-87) many valuable papers are printed. Among the contents we may note: the sense of smell, being Part III. of Prof. Haycraft's treatise on "The Objective Cause of Sensation"; on transition resistance at the surface of platinum electrodes, and the action of condensed gaseous films, by Mr. W. Peddie; researches on the problematical organs of the Invertebrata, by Dr. A. B. Griffiths; the salinity and temperature of the Moray Firth, and the Firths of Inverness, Cromarty, and Dornoch, by Dr. H. R. Mill; on the minute oscillations of a uniform flexible chain hung by one end, and on the functions arising in the course of the inquiry, by Dr. E. Sang; notes on the biological tests employed in determining the purity of water, by Dr. A. W. Hare; glories, halos, and coronæ seen from Ben Nevis Observatory, extracts from log-book, by Mr. R. T. Omond; on glories, by Prof. Tait; rectilineal motion of viscous fluid between two parallel planes, by Sir W. Thomson; and the thermal windrose at the Ben Nevis Observatory, by Mr. A. Rankine.

At a recent meeting of the Wellington (New Zealand) Philosophical Society a paper was read by Mr. E. Tregear on "The Origin of Fire" according to Polynesian folk-lore. Mr. Tregear read from Sir George Grey's work the Maori legend of the procuring of fire from the old fire-goddess Mahuika by the hero Maui who had the power of becoming a bird at will, and compared this with the Samoa version in which the fire-deity is a male person, from whom Maui procures fire, having vanquished him in a personal encounter. In the legend of another of the islands the place of Mahuika as fire-deity is taken by the great Polynesian god Tangaroa. From the fact that in these legends the path by which fire was reached was always downwards into the centre of the earth, Mr. Tregear suggests that it was probable that the ancestors of the Polynesians had experience of natural fire drawn from volcanic sources, but to Maui is due the discovery in Polynesia of fire by friction. With regard to Maui himself there is great difficulty in the parent-names. The assumption by him at will of the form of the dove or of the hawk is consistent with the belief in the ancient world of the various shapes assumed by deities when desirous of accomplishing their purposes. The "seed of fire," an expression used in traditions for the inflammable nature of certain kinds of timber, was a common idiom in ancient Continental nations. Fire-worship continued to have its devotees in Europe until comparatively recent times; and the sacred fire was always "new fire" which had not previously been used for any purpose. being kindled by friction. A legend is preserved in Eastern Polynesia of the descent of the Maori people from a race whose name is the same as that of the fire-kindling instrument used in India, and it is remarkable that the deity who forges the thunderbolts in India is probably identical in name with the thunder-god of the Maoris.

Dr. George M. Dawson has contributed to the Transactions of the Royal Society of Canada (vol. v. section 2, 1887) a valuable series of notes and observations on the Kwakiool people of Vancouver Island. Referring to the question as to the best means of doing good service to the Kwakiool, Dr. Dawson says it is primarily essential to establish among them industries which will remove the temptation now felt to drift to the larger settlements and towns. The Kwakiool, with other Indians of the coast, already cultivate in a desultory manner small crops of potatoes, on such minute patches of open ground (generally the sites of old villages) as are to be found along the shore. Their bent, however, is not that of an agricultural people, and the densely-wooded character of their country calls for labour, herculean in proportion to the unsystematic efforts of these people, before it can be cleared and reclaimed for agriculture on any large scale. They are excellent boatmen and fishermen in their own way, and Dr. Dawson has no doubt that under favourable conditions they would readily learn to build boats, make nets, and cure fish in such a manner that the product would be marketable. To effect these objects the most essential step, in Dr. Dawson's opinion, is the establishment of industrial schools, where the younger people may be separated from their old associations and instructed in various callings appropriate to their condition and surroundings.

WE have received the Report of the Rugby School Natural History Society for the year 1887. This is the twenty-first issue. The editors point out that owing to various causes a perhaps unusually large number of the meetings were taken up with lectures. Among the contents are two exceptionally interesting papers: one on "Specialization," by Mr. E. Solly, and one on "Natural History in Southern Germany," by Mr. E. E. Austen.

MR. E. STANFORD has issued a pamphlet, by Mr. F. A. Velschow, of Copenhagen, on "The Natural Law of Relation between Rainfall and Vegetable Life, and its Application to Australia." The object of the paper is to show why, in the author's opinion, the regularity of the downpour of rain "depends directly on one particular quality appertaining to vegetable life." He also undertakes to prove that "vapour rarefies the atmosphere instead of increasing its specific gravity, as is now supposed."

THE last Calendar of the Imperial University of Japan, to which we have already briefly referred, shows in a very striking manner how the Japanese are beginning to rely upon themselves for instruction in matters relating to higher education. The following figures will show to what extent the Japanese now avail themselves of European assistance in their University:—(1) Law Department: 19 professors, assistants, and lecturers, of whom 5 are foreigners; (2) Department of Medicine: 53 professors and assistants, of whom 2 are foreigners; (3) Engineering Department: 33 professors, assistants, and lecturers, of whom 4 are foreigners; (4) Literature Department: 19 professors and lecturers, of whom 6 are foreigners; (5) Department of Science: 25 professors and assistants, of whom 2 are foreigners. The academical and other qualifications of the Japanese professors and lecturers appear in most cases to be all that could be expected from men holding their positions. The distribution of the foreign professors and lecturers in the University is, we believe, as follows: eight British, eight Germans, two Frenchmen, and one American. Not many years ago a large majority of the *employés* of the University of Tokio, as it was then called, were Americans; and of the present number of foreigners the majority appear to be employed in teaching foreign systems of law and foreign languages. We notice the appointment for the first time of a Professor of Sanitary Engineering, wherein the Japanese University is in advance of nine-tenths of the educational institutions of the West. It is also curious to notice that the Professor of Japanese Philology and Literature is an Englishman.

ELLIS'S "Irish Education Directory and Scholastic Guide" for 1888 has just been issued. The publication of the volume has been delayed in consequence of the many important changes made in the regulations of the medical licensing bodies in Ireland. During the past year the work has been carefully revised, and it contains full information as to the Irish Universities and professional schools, and the institutions of Ireland for promoting intermediate and primary education. There are also complete alphabetical lists of Irish colleges and schools, and copious alphabetical and classified indices.

THE examination papers set in 1887 in connection with the Royal University of Ireland have been published in a separate volume as a supplement to the University Calendar for the year 1888.

ACCORDING to *Allen's Indian Mail*, the principle of payment by results in the primary schools, has not been altogether successful in India. Last year it proved a failure in Kachar, and this year it is having its final trial in Assam. The teachers in charge of certain selected schools were offered their choice of fixed salaries or payment by results, and if they did not work the latter system successfully they were to revert to the former. The rules for payment by results have recently been revised, larger rewards being offered, and the scheme has been opened to all primary schools.

ON Monday a deputation representing Islington, Hackney, and Stoke Newington, waited upon Mr. Anstie, Charity Commissioner, to confer with him about a proposed scheme of Technical Institutes for the North of London. Mr. Anstie was reminded that the Commissioners had suggested to a previous deputation that St. Pancras, Islington, Hackney, and Stoke Newington should combine in order to formulate an educational scheme which would benefit the North of London. Since that time three of the parishes—Hackney, Islington, and Stoke Newington—had met, but St. Pancras had declined to join them, and they now desired to know what assistance they could get out of the City Parochial Funds for their scheme. The deputation said it would be difficult to raise money, but, supposing that they raised £60,000 in Islington and Hackney, could the Charity Commissioners promise them one-half of that amount? Mr. Anstie replied that the Charity Commissioners' proposal to South London was to contribute pound for pound, to be applied rather to permanent endowments than to pay any preliminary expenses. The Commissioners were very anxious in any scheme that was proposed that provision should be made for children between the ages of 13 and 16 to continue their instruction, and they particularly wished to benefit the poorer classes. In fact, they were bound to do so under the provisions of the Act. If St. Pancras stood outside, then the Commissioners would have to treat with the three parishes alone. He urged them very strongly to use every effort to get as much money as possible. The Commissioners would look most favourably upon a scheme which contained in it the promise of the largest contributions.

DURING the approaching summer a new branch of the London Geological Field Class will make a detailed study of the Chalk formation under the direction of Prof. H. G. Seeley, F.R.S. The other branch under the same direction will follow the course of former years by investigating the principal geological features in the neighbourhood of London. Full particulars can be had by intending students on application to Messrs. G. Philip and Son, 32 Fleet Street, and from many booksellers in the suburbs.

THE additions to the Zoological Society's Gardens during the past week include a Shining Parrakeet (*Pyrrhulopsis splendens*) from the Fiji Islands; two Banded Grass Finches (*Poëphila cincta*); two Bicheno's Finches (*Estrelda bichenovii*) from Queensland; two Mandarin Ducks (*Æx galericulata*) from China, purchased; a white-fronted Lemur (*Lemur albifrons* born in the Gardens.